

## PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING  
OF A CHANGE(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

Date of mailing (day/month/year)  
19 August 2002 (19.08.02)

From the INTERNATIONAL BUREAU

To:

SHA, Jay  
Jeekai & Partners  
Suite 602  
Jinyu Tower  
A129 West Xuan Wu Men Street  
Beijing 100031  
CHINE

RECEIVED  
SEP 13 2002  
TC 1700

Applicant's or agent's file reference CPS10381	IMPORTANT NOTIFICATION		
International application No. PCT/CN01/00099	International filing date (day/month/year) 22 January 2001 (22.01.01)		

## 1. The following indications appeared on record concerning:

the applicant  the inventor  the agent  the common representative

Name and Address JZANG, Tianfu Zao Jun Xi Li Building No. 2 Apt. 1-501 Haidian District Beijing 100081 China	State of Nationality CN	State of Residence CN
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

## 2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

the person  the name  the address  the nationality  the residence

Name and Address JIANG, Tianfu Zao Jun Xi Li Building No. 2 Apt. 1-501 Haidian District Beijing 100081 China	State of Nationality CN	State of Residence CN
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

## 3. Further observations, if necessary:

## 4. A copy of this notification has been sent to:

<input checked="" type="checkbox"/> the receiving Office	<input checked="" type="checkbox"/> the designated Offices concerned
<input type="checkbox"/> the International Searching Authority	<input type="checkbox"/> the elected Offices concerned
<input type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Ingrid AULICH (Fax 338.89.65)
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

## PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

COMMUNICATION IN CASES FOR WHICH  
NO OTHER FORM IS APPLICABLE

Date of mailing (day/month/year) 27 August 2002 (27.08.02)	To:  SHA, Jay Jeekai & Partners Suite 602 Jinyu Tower A129 West Xuan Wu Men Street Beijing 100031 CHINE
Applicant's or agent's file reference CPS10381	<b>REPLY DUE</b> see paragraph 1 below
International application No. PCT/CN01/00099	International filing date (day/month/year) 22 January 2001 (22.01.01)
Applicant JIANG, Tianfu	

1.  REPLY DUE within \_\_\_\_\_ months/days from the above date of mailing  
 NO REPLY DUE, however, see below  
 IMPORTANT COMMUNICATION  
 INFORMATION ONLY

## 2. COMMUNICATION:

It has been brought to the attention of the International Bureau that in respect of the above-identified application, the international publication No. WO 02/057391 published on 25 July 2002 (25.07.02) erroneously indicated, under item (72) in the front page, the name of the inventor as "JZANG, Tianfu". The correct name is JIANG, Tianfu.

The International Bureau shall republish a correction in Section II of the PCT Gazette. A corrected version of the corresponding PCT pamphlet will be published as early as possible.

A copy of this Notification is being sent to the receiving Office (RO/CN) and to the designated/elected Offices concerned.

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2002 JUL 22  
PCT/IB/345

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland  Facsimile No. (41-22) 740.14.35	Authorized officer Anman QIU (Fax 338.89.65)  Telephone No. (41-22) 338.83.38
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## PATENT COOPERATION TREATY

10/0198/6

PCT

**NOTIFICATION OF THE RECORDING  
OF A CHANGE**

(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

<p><b>The International Bureau of WIPO</b> <b>34, chemin des Colombettes</b> <b>1211 Geneva 20, Switzerland</b></p>	<p><b>Authorized officer</b></p>
	<p><b>Jaime LEITAO</b></p>
<p>Facsimile No.: (41-22) 740.14.35</p>	<p>Telephone No.: (41-22) 338.83.38</p>

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

PCT/CN01/00099

International Application No.

22 JAN 2001 (22.01.01)

International Filing Date

PO/CON 2001-00099  
PCT International Application

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference  
(if desired) (12 characters maximum) CPS10381

Box No. I TITLE OF INVENTION

METHOD AND SYSTEM OF CONVERTING WASTE PLASTICS INTO HYDROCARBON OIL

Box No. II APPLICANT

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

JIANG Tianfu

Zao Jun Xi Li, Building No. 2, Apt. 1-501  
Haidian District, Beijing 100081  
People's Republic of China

This person is also inventor.

Telephone No.

6215-4294

Faxsimile No.

Teleprinter No.

State (that is, country) of nationality:  
People's Republic of China

State (that is, country) of residence:  
China

This person is applicant  all designated States  all designated States except the United States of America  the United States of America only  the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

CHEN Yanping CHEN, Yanping

Zao Jun Xi Li, Building No. 2, Apt. 1-501  
Haidian District, Beijing 100081  
People's Republic of China

This person is:

applicant only

applicant and inventor

inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:  
People's Republic of China

State (that is, country) of residence:  
China

This person is applicant  all designated States  all designated States except the United States of America  the United States of America only  the States indicated in the Supplemental Box

Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

Jay Sha  
Jekai & Partners  
Suite 602, Jinyu Tower  
A129 West Xuan Wu Men Street  
Beijing 100031, P. R. China

agent

common representative

Telephone No.

86 10 6641-1409

Faxsimile No.

86 10 6641-1419

Teleprinter No.

Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

PATENT COOPERATION TREATY

From: the RECEIVING OFFICE

To:

100031

Suite 602, Jinyu Tower A129 West Xuan Wu Men  
Street Beijing 100031, P.R.China

Jeekai & Partners

PCT

NOTIFICATION REGARDING CERTAIN  
CORRECTIONS MADE *EX OFFICIO*

(PCT Administrative Instructions, Section 327)

Date of mailing (day/month/year)

01.Mar 2001 (01.03.01)

Applicant's or agent's file reference <b>CPS10381</b>	REPLY DUE <b>NONE</b> However, see last paragraph 3 below
International application No <b>PCT/CN01/00099</b>	International filing date (day/month/year) <b>22.Jan 2001 (22.01.01)</b>
Applicant <b>JIAN, Tianfu et al</b>	

1. The applicant is hereby notified that this receiving Office has corrected formal defects in the international application *ex officio*, as shown on the attached copy of:

the request, sheet No.: 1,2,3

the description, sheet No.: \_\_\_\_\_

the claims, sheet No.: \_\_\_\_\_

the drawings, sheet No.: \_\_\_\_\_

other (*specify*): \_\_\_\_\_

2. If the applicant agrees with these corrections, no further action is required in this regard.

3. In case of disagreement with these corrections, the applicant should promptly inform this receiving Office accordingly.

China State Intellectual Property Office (RO/CN) 6, Xitucheng Road, Jimen Bridge, Haidian District. Beijing, 100088, P.R.China Facsimile No. 86-10-62019451	Authorized officer: <b>YAO, Xiaohong</b> Telephone No: 86-10-62093677
--	---

Sheet No. 2

## Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

GUO WUJI GUO, Wuji  
Zao Jun Xi Li, Building No. 2, Apt. 1-501  
Haidian District, Beijing 100081  
People's Republic of China

This person is:

applicant only  
 applicant and inventor  
 inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:  
People's Republic of ChinaState (that is, country) of residence:  
China

This person is applicant for the purposes of:  all designated States  all designated States except the United States of America  the United States of America only  the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

applicant only  
 applicant and inventor  
 inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of:  all designated States  all designated States except the United States of America  the United States of America only  the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

applicant only  
 applicant and inventor  
 inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of:  all designated States  all designated States except the United States of America  the United States of America only  the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

applicant only  
 applicant and inventor  
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## Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

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Check-box reserved for designating States which have become party to the PCT after issuance of this sheet:

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**Precautionary Designation Statement:** In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)

4  
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25 July 2002 (25.07.2002)

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(71) Applicants (for all designated States except US): CHEN, Yanping [CN/CN]; Zao Jun Xi Li, Building No. 2, Apt. 1-501, Haidian District, Beijing 100081 (CN). GUO, Wuyi [CN/CN]; Zao Jun Xi Li, Building No. 2, Apt. 1-501, Haidian District, Beijing 100081 (CN).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

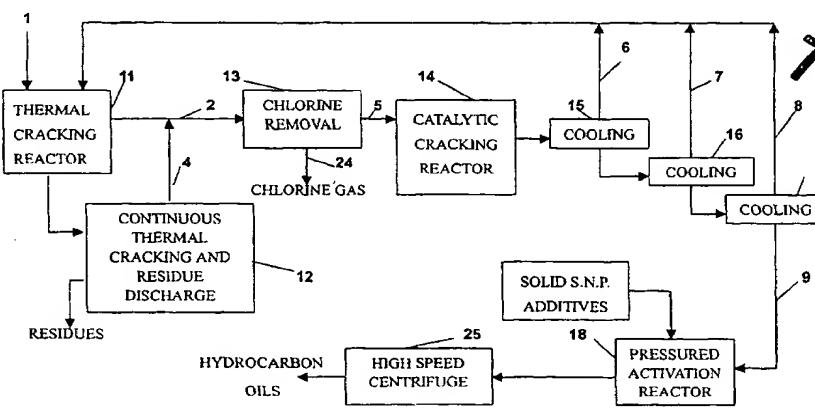
(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published:**

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(71) Applicant and  
(72) Inventor: JZANG, Tianfu [CN/CN]; Zao Jun Xi Li, Building No. 2, Apt. 1-501, Haidian District, Beijing 100081 (CN).  
(74) Agent: SHA, Jay; Jekai & Partners, Suite 602, Jinyu Tower, A129 West Xuan Wu Men Street, Beijing 100031 (CN).

**(54) Title:** METHOD AND SYSTEM OF CONVERTING WASTE PLASTICS INTO HYDROCARBON OIL

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SEP 6 2002  
TC 170U

WO 02/057391 A1

(57) **Abstract:** A system and method of converting waste plastics into hydrocarbon oil comprises a thermal cracking reactor (11), into which the waste plastics are cracked at a temperature in the range of 270-800 °C to obtain partly gaseous hydrocarbons, partly liquid hydrocarbons, and remaining residues. A continuous thermal cracking and residual discharging portion (12) is connected to have the liquid hydrocarbons gradually and fully cracked into gaseous hydrocarbons, while the residues are discharged at a residual discharge outlet. A chlorine removal portion (13) is connected to receive the gaseous hydrocarbons to remove chloring from it. A catalytic cracking reactor (14) is connected to the chlorine removal portion to have the gaseous hydrocarbons catalytic cracking with an acid catalyst. A three-stage cooling portion (15, 16, 17, 18) is adopted to have the catalytically cracked gaseous hydrocarbons fully converted into liquid hydrocarbons, i.e., hydrocarbon oil. A pressurized activation reaction portion (19) is provided to remove few amount of S.N.P. from the liquid hydrocarbons to obtain purified hydrocarbon oils.

## METHOD AND SYSTEM OF CONVERTING WASTE PLASTICS INTO HYDROCARBON OIL

### Field of the Invention:

5 The present invention relates to a plastic oil extraction technology, and more particularly to a method of converting waste plastics into hydrocarbon oil, and a system for carrying out the same.

### Background of the Invention:

10 The plastic oil extraction technology, or POET in short, has been used in processing solid wastes generated in urban areas and in industries. However, as noted in the research, it appears that there is still no practically applicable method and system of converting waste plastic into hydrocarbon oil. Most of the researchers in this particular field focus on the conversion of high polymer  
15 compositions into polymers of smaller molecules by utilizing thermal cracking of high temperature and high pressure, catalysts, while the operation platform used is either an oven type reactor or tubular type reactor. It is believed that the former reactor may be good for melting the solid plastics, but may not ensure the sufficient cracking, and discharge the residues efficiently, while the latter reactor is  
20 just opposite. The tubular reactor may efficiently discharge the residues of the cracking, but may not be suitable for processing directly the solid waste plastics.

The plastic oil extraction technology of prior art usually includes thermal cracking, catalytic cracking, and cooling. One of the prior methods and systems is disclosed  
25 in EP 0 607 862 A. In order to obtain purified hydrocarbon oil, it utilizes a neutralization tank, in which the low-boiling hydrocarbon oil is subject to neutralization in a 20% sodium hydroxide aqueous solution, and an oligomerization tank, in which the cracking gas component is subject to oligomerization in a 100% phosphoric acid in addition to the aforesaid thermal,  
30 catalytic cracking and cooling. The other prior method or system is disclosed in WO 00/64997 of the same inventor, Mr. Tianfu JIANG. In that system, a subsidiary reactor is used to have the residues of the main thermal cracking reactor undergone a secondary thermal cracking so as to ensure the waste plastics fully gasified, and a heavy oil separator is used to recycle the heavy oil back to the

catalytic cracking reactor for further catalytic cracking.

However, the POET is aimed to process a mixture of hardly defined wastes plastics, containing many non-recyclable plastics, such as PP, PE, PVC, PET, PS, 5 etc. in urban and industrial plastic wastes. Therefore, the conversion process from the solid wastes into a gaseous state can be hardly controlled. Thus, it creates lots of difficulties in the industrial application. This is probably the main reason why the plastic oil extraction technology has not been really put into practical use. The present invention is developed and perfected through many years of industrial 10 research and practical testing. The present invention has solved the aforesaid difficulties, and thus can be readily adopted in the industrial application.

An object of the present system is to provide a method and system of converting the solid plastic wastes efficiently and thoroughly into pure and clean hydrocarbon 15 oils of high calorie value up to about 11000 great calories per kilograms, and of a weight ratio of about 0.8. Such hydrocarbon oils can be used on any types of oil injection nozzle, and thus it can be widely used in the industry.

Another object of the present invention is to provide a system utilizing the 20 combination of an oven reactor and a tubular reactor such that it can process various kinds of plastic wastes.

A still further object of the present invention is to provide a method and system of converting the solid plastic wastes into hydrocarbon oil without hazard 25 hydrochloride.

### **Summary of the Invention**

In accordance with the present invention, a system of converting waste plastics into hydrocarbon oils comprises a thermal cracking reactor, into which solid waste 30 plastics are fed and in which said waste plastics are cracked at a temperature in a range of 270-800°C to obtain a thermal cracking resultant of partly gaseous hydrocarbons, partly a mixture of liquid hydrocarbons and residues; a continuous thermal cracking and residual discharging portion connected to receive automatically the mixture of liquid hydrocarbons and residues from the thermal

cracking reactor, in which the liquid hydrocarbons are gradually and fully cracked into gaseous hydrocarbons when passing through the thermal cracking and residual discharge portion, while the dry residues from the previous thermal cracking and new residues generated from the further thermal cracking are 5 discharged at a residual discharge outlet of the thermal cracking and residue discharge portion; a hydrochloride removal portion connected to receive the gaseous hydrocarbons, respectively, from the thermal cracking reactor and from the continuous thermal cracking and residual discharge portion; a catalytic cracking reactor being connected to the hydrochloride removal portion in which the 10 gaseous hydrocarbons from the hydrochloride removal portion is subject to catalytic cracking with an acid catalyst; a cooling portion through which most of the gaseous hydrocarbons after the catalytic cracking are substantially converted into liquid hydrocarbons, and remaining non-convertible gaseous hydrocarbon substances are transported back to a burning chamber which compensates the 15 heating of the thermal cracking reactor; and an pressurized activation reaction portion provided to receive the liquid hydrocarbons from the cooling portion to solidify few amount of sulfur nitrogen phosphorus contained in the liquid hydrocarbons so as to obtain purified hydrocarbon oils, thereby reducing the generation of SO<sub>x</sub> and NO<sub>x</sub>.

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The thermal cracking and residual discharge portion consists of continuous thermal reacting tubes of parallel arrangement. A mixture of the melting waste plastics and other impurities, that is, liquid hydrocarbons and residues, is pushed forward by screw conveyors mounted inside the tubes, and thus passes through 25 the thermal reacting tubes, while the mixture is maintained at a high temperature sufficient to enable further gasification of the melting wastes plastics, or rather liquid hydrocarbons, to ensure the sufficient thermal cracking of the gaseous hydrocarbons.

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The hydrochloride removal reaction of the present invention is to have the thermal cracking resultants, i.e., gaseous hydrocarbons, in reaction with alkaline substances to replace the chlorine from hydrochloride contained in the thermal cracking resultants so as to obtain purified gaseous hydrocarbons. The hydrochloride removal reaction is at a high temperature. After the reaction, the

gaseous hydrocarbons are almost hydrochloride free.

The cooling portion of the present invention consists of three stages of cooling, whereby gaseous alkene of large molecules will be substantially converted into 5 gaseous alkene of small molecules, such as eight to twenty carbon atoms, and eventually become liquid hydrocarbons, leaving only few non-convertible gaseous hydrocarbon substance, that is, non-convertible at room temperature and pressure. Such non-convertible gaseous hydrocarbon substances will be sent back to the burning chamber for the thermal cracking reactor to compensate the heating 10 supply for the thermal cracking reaction.

#### **Brief Description of the Drawings**

Fig. 1 is an illustration of a system in accordance with the present invention;

Fig. 2 illustrates the structure of the continuous thermal cracking and residual 15 discharge portion of the present invention; and

Fig. 3 is an illustration of the structure of the chlorine removal portion.

#### **Detailed Description of the Invention**

The raw waste materials are usually urban and industrial waste plastics, that 20 normally contain many non-recyclable plastics, such as PP, PE, PVC, PET, and PS, etc. For recycling those waste plastics, some kinds of pretreatment may be required. Usually, such waste plastics are sorted roughly at individual homes or wastes collection sites before they are brought to a recycling plane. At the recycling plane, the waste plastics are subject to separation by one or more 25 separator. There are normally magnetic selection separators and air-blowing selection separators. The magnetic selection is primarily for separating the relatively big metal wires, or other metal parts, while the air-blowing (or wind) selection is primarily for separating dust or dirt contained in the wastes, and reducing water contents.

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After the pretreatment, the waste plastics are sent to the system of the present invention. Such a system usually contains a material feeding system (not shown) to prevent the feeding materials from spilling out, and prevent the gas seepage from the reactors to avoid any ignition of burning and explosion. The feeding

system may use an automatic piston of hydraulic pressure control that does not require crashing the waste materials, or use a screw-propelling feeding system that requires crashing the wastes materials before feeding. The latter system may reduce the dust or dirt in the processed waste materials.

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Then, the waste plastics enter the thermal cracking reactor 11 through the feeding system at the feeding entry 1 with reference to Fig. 1. The thermal cracking reactor 11 is an oven type reactor, and it is a cylindrical and sealed container made of titanium steel. The outside of the thermal cracking reactor 11 is normally 10 provided with a heating furnace sleeve (not shown) and an automatic ignition system (not shown) in association with the heating furnace. The temperature inside the thermal cracking reactor is controlled at 270-800°C, and the pressure inside the oven reactor is the environmental atmosphere or pressure. Once the waste plastics get into the reactor, they start the thermal cracking reaction at 15 270-800°C, and the molecule chains of the plastics are gradually broken. The practical test shows that 30% of the solid waste plastics become gasified soon after they become liquid in the thermal cracking reactor 11 at a matter of few seconds. Thus, the thermal cracking resultants are about 30% gaseous hydrocarbons, as well as about 70% of a mixture of non-gasified liquid 20 hydrocarbons substances and other residues, that is, melting waste plastics.

As shown in Fig. 1, the mixture of gaseous hydrocarbons substances and residues, the melting waste plastics, are led from the thermal cracking reactor 11 to a hydrochloride removal portion 13, while the melting waste plastics are passed to 25 the continuous thermal cracking and residual discharging portion 12 that is a tubular thermal reactor. In the 70% melting plastics are mixed of various impurities, such as carbonized material and dirt etc. These melting plastics pass uniformly through the heated continuous thermal cracking and residual discharging portion that consists of several sets of reacting tubes of acid resistant, i.e., 30 so-called tubular type of reactor. This portion also functions as a residual discharging system. During this process, the inside temperature of the reacting tubes is maintained at 270-800°C to ensure fully thermal cracking reaction.

With reference to Fig. 2, the tubular thermal cracking and residual discharging

portion 12 comprises a plurality, such as five or six, sets of steel tubes 3 of predetermined length that are parallel arranged. The screw propellers or conveyors 20 mounted inside the steel tubes rotate at opposite directions in adjacent tubes, and the entire portion 12 is placed within a heating sleeve with a 5 temperature at 270-800°C. The metal screw propellers or conveyors propel the melting plastics forward such that the 70% melting plastics pass the heated tubes and the residues enter the residual discharging system. As accurately calculated, the length of the tubes 3 and the rotation speed are set such that the melting liquid plastics pass the whole system at a predetermined speed such that the melting 10 plastics are fully gasified before reaching to the end of the continuous thermal cracking and residual discharging portion 12, and the gaseous thermal cracking resultants are led out of a gas outlet 4 to the hydrochloride removal portion 13. The impurities in the melting plastics become powder substances to be eventually 15 discharged at the other outlet of the continuous thermal cracking and residual discharging portion. The stability and continuity of the industrial production are maintained by the continuous and constant feeding of the materials.

The hydrochloride removal portion 13 of the present invention is shown in Fig. 3. The art used here is different from the dry or damp neutralization method currently 20 used in the industry. This is a new technology of hydrochloride removal at high temperature, whereby the existence of hydrochloride in the gaseous hydrocarbons is minimized or almost eliminated. The catalysts are made of several alkaline compounds and heavy metal elements to form metathetic substances, and they are reusable so as to increase the side products, chlorine gas (Cl<sub>2</sub>), and reduce 25 the cost.

In the gaseous hydrocarbons of high temperature generated from the thermal cracking reactor and the continuous thermal cracking and residual discharging portion, there could be certain amount of hydrochloride (HCl). As studies show, 30 there are about 5-15% plastics among the urban solid wastes, and about 5% of the plastic wastes are PVC. The PVC materials are hard to be separated from other plastic wastes, if mixed, and the PVC will generate HCl through thermal cracking. The aforesaid gaseous hydrocarbons pass the acid-resistant pipelines. The temperature of the hydrochloride removal system 13 is maintained at

270-800°C. Because of the effect of the metathetic substances, the gaseous hydrochloride in the gaseous hydrocarbon substances will become solidified rapidly so as to ensure that the amount of hydrochloride in the gaseous hydrocarbons is almost zero, i.e., almost hydrochloride free.

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As shown in Fig. 3, the gaseous hydrocarbons and the mixed few amount of hydrochloride pass the pipeline 2 (Fig. 1), and enter the hydrochloride removal portion 13. Then they react with the specific metathetic substances 26 under the condition of a temperature of 270-800°C to have the chloride ion solidified to form 10 compounds. Other gaseous hydrocarbon substances will enter through a pipe 10 into a setting bed 22. The outer portion 23 of the hydrochloride removal portion 13 is a heating sleeve, provided to maintain the condition of removing hydrochloride, i.e., the high temperature. As accurately calculated, it is possible to have the metathetic substances saturated within a predetermined time interval. 15 In this case, the pipeline 2 can be switched to another identical hydrochloride removal portion. The reaction state is the same as that discussed above.

At the same time, the first hydrochloride removal portion receives hot air through the pipeline 21 to react with the metathetic substances. The chlorine element 20 contained therein will be replaced and changed into chlorine gas, and then expelled, through the pipe 24, together with the hot air out of the hydrochloride removal portion 13. Then, the expelled gas enters the chlorine separation system to collect chlorine gas.

25 Upon leaving the hydrochloride removal portion 13, the gaseous hydrocarbons enter a catalytic cracking reactor 14. The gaseous hydrocarbons of high temperature, under the effect of a special catalyst, will be rapidly cracked again into gaseous hydrocarbons substances of much smaller molecule compositions. More specifically, the catalyst can be repeatedly used to reduce the cost.

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The cooling portion of the present invention includes a three-stage cooling and condensing 15, 16, 17. The gaseous hydrocarbons coming out of the catalytic cracking portion have undergone the cracking reaction twice, respectively, in the thermal cracking reaction and the catalytic cracking reaction. The big molecules of

the gaseous hydrocarbons may have been completely broken up so as to obtain gaseous hydrocarbon of smaller molecules, such as eight to twenty carbon atoms. Then, after the three-stage cooling and condensing, about 85-90% of the gaseous hydrocarbons become liquid hydrocarbons, i.e., hydrocarbon oils, while the 5 remaining substances will pass through the pipelines **6, 7, 8** (Fig. 1) and be lead, through a LPG recovery system, into a burning chamber (not shown) to compensate the heating of the thermal cracking reactions. The aforesaid remaining substances are non-convertible hydrocarbon substances that can only be gaseous under the normal temperature and pressure, such as methane, butane, 10 etc.

The system of the present invention further includes a pressurized activation reactor **18**. This reactor provides 0.8-1 atmosphere and normal temperature as the reaction conditions, and adds special additives to enhance the fluidity of the 15 hydrocarbon oils, to have the hydrocarbon oils further cracked, and to increase the calorie value of the resulting hydrocarbon oils. In the meantime, due to the effect of the additives, a small amount of sulfur, nitrogen, phosphorus elements contained in the liquid hydrocarbons are solidified so that the resulting hydrocarbon oils become highly purified. A high-speed centrifuge **25** may be 20 adopted to extract the purified hydrocarbon oils (Fig. 1).

The method of the present invention is described hereinafter. The waste plastics are fed into the thermal cracking reactor **11** through the material entry **1**. The thermal cracking reaction is carried out in an oxygen free environment, at a 25 temperature of 270-800°C, and under the environmental atmosphere pressure. It is confirmed that about 30% of the solid waste plastics become gaseous products soon after they become liquid. Then, the thermal cracking resulting gas passes through the pipeline **2** and enters into the hydrochloride removal portion **13**.

30 The remaining 70% melting liquid plastics in the thermal cracking reactor **11** are mixed with impurities, and pass through a control valve (not shown) at the bottom outlet of the thermal cracking reactor **11**, entering into the continuous thermal cracking and residual discharging portion **12**. The melting plastics flow gradually through the tubes **3** (Fig. 2) of the continuous thermal cracking and residual

discharging portion 12. There, the melting liquid plastics are further thermally cracked, and become gasified. The thermal cracking resulting gaseous hydrocarbon substances enter the hydrochloride removal portion 13 through the pipeline 4.

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With the completion of the gasification at the end of the continuous thermal cracking and residual discharging portion 12, the dry residuals are expelled through the metal screw conveyors 20 inside the tubes 3. Through the pipelines 2 and 4, the gaseous hydrocarbon substances after the thermal cracking enter into 10 the hydrochloride removal system 13. The special metathetical substances will capture the chloride ion of the gaseous hydrochloride to generate chlorine gas. The resulting chlorine gas is expelled out of the removal portion 13. Then, the gaseous hydrocarbons are almost hydrochloride free. The gaseous hydrocarbons substances pass through the pipeline 5 and enter the catalytic 15 cracking reactor 14. In the catalytic reactor 14, the gaseous hydrocarbons are catalytically cracked under the effect of an acidic catalyst to become light groups of gaseous hydrocarbon substances of small molecules. Then, the catalytic cracking resultants enter the three cooling and condensing stages 15, 16, 17 to obtain liquid hydrocarbons of small molecules.

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When the gaseous hydrocarbon substances pass the through three cooling stages, any gaseous hydrocarbon substances, that may become liquid hydrocarbons, will change into the liquid hydrocarbons. These are the basic extracted oil components. Most of them, however, are unsaturated alkene substances. At the normal 25 temperature and pressure, the still gaseous hydrocarbons substances are non-convertible LPG. These non-convertible gaseous hydrocarbons or LPG will be led through the pipelines 6, 7, 8 and LPG recovery system back to the burning chamber for the thermal reaction or return to the heating furnace sleeve of the thermal cracking reactor 11 to compensate the heating capacity.

30

The collected liquid hydrocarbons pass through the pipeline 9 and an oil pump (not shown), and then enter the activation reactor 18. Under the reaction condition of 0.8-1 atmospheres, a special industrial additive is added into the activation reactor 18. There, few amount of sulfur, nitrogen, phosphorus elements contained in the

liquid hydrocarbons become solid, while the liquid hydrocarbons get further cracked to increase the percentage of the saturated hydrocarbons. Then, these saturated hydrocarbons become purified and clean light hydrocarbon oils of high fluidity and high calorie value.

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In accordance with the present invention, the removal of hydrochloride is carried out at a high temperature. It is believed that such hydrochloride removal is not known before, that is, removing hydrochloride at a high temperature, for instance, 270-800 °C. The hydrochloride mixed in the gaseous hydrocarbons of high 10 temperature forms an acidic mixture of high temperature. The hydrochloride is removed first to ensure that the gaseous hydrocarbons enter the setting bed (molecule sieve) safely without damaging the catalyst therein. Here, the metathetic substances can be recycled for repeated use to reduce the cost.

15 The conventional technique of hydrochloride removal is based on dry method or damp method. The principle is the neutralization of acid and alkaline. Such a method would require a large amount of calcium oxide in case there is a large amount of hydrochloride. At the same time, it would generate a large amount of calcium chloride. Therefore, in practice, it may create some troubles during the 20 transportation, additional resultants, and other technical treatment difficulties. Thus, it would increase the operation cost.

When removing hydrochloride at a high temperature, the specific catalyst may replace the chlorine through certain oxidation after it absorbs the chloride ion. 25 Thus, it not only reduces the operation cost, but also avoids the generation of the large quantity of useless inorganic salt. Further the cost may be reduced because there is no large amount of alkaline neutralizers required, and no need to deal with the large amount of generated inorganic salt. Moreover, there is no useless resultant. The resulted chlorine gas is still of marketable value.

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The scope of protection of the present invention is set out in the following claims. However, any obvious modification without excess of essence of the present invention should also be within the scope of the present invention.

## CLAIMS

1. A system of converting waste plastics into hydrocarbon oil comprising:
  - (1) a thermal cracking reactor, into which solid waste plastics are fed and in which said waste plastics are cracked at a temperature in a range of 270-800°C to obtain a thermal cracking resultant of partly gaseous hydrocarbons and partly a mixture of liquid hydrocarbons and residues;
  - (2) a catalytic cracking portion coupled to receive said gaseous hydrocarbons, in which the gaseous hydrocarbons are cracked with an acidic catalyst; and
  - (3) a cooling portion in which the gaseous hydrocarbons after the catalytic cracking are substantially converted into liquid hydrocarbons of smaller molecules, and remaining non-convertible gaseous hydrocarbon substances are transported back to compensate the heating of the thermal cracking reactor, CHARACTERIZED IN THAT:
  - (4) a continuous thermal cracking and residual discharging portion is connected to receive the liquid hydrocarbons and residues from said thermal cracking reactor, such that the liquid hydrocarbons are gradually and fully thermally cracked into gaseous hydrocarbons when passing through the continuous thermal cracking and residual discharging portion, while the dry residues from the previous thermal cracking and new residues generated from the further thermal cracking are discharged at a residual discharge outlet of the continuous thermal cracking and residual discharging portion.
2. The system of claim 1, characterized by further comprising a hydrochloride removal portion connected before the catalytic cracking portion to receive the gaseous hydrocarbons, respectively, from the thermal cracking reactor and from the continuous thermal cracking and residual discharging portion, in which the gaseous hydrocarbons are subject to reaction with an alkaline metathetic substance at a high temperature such that the resulting gaseous hydrocarbons are almost chlorine free; said catalytic cracking reactor being connected to said hydrochloride removal portion to receive the chlorine-free gaseous hydrocarbons and having said gaseous hydrocarbons subject to catalytic

cracking with said acid catalyst.

3. The system of claim 1 or 2, characterized by further comprising a pressurized activating reaction portion provided to receive said liquid hydrocarbons from the cooling portion to solidify few amount of sulfur, nitrogen, phosphorus contained in said liquid hydrocarbons so as to obtain purified hydrocarbon oils.
4. The system of claim 1, characterized in that said continuous thermal cracking and residual discharging portion comprises a plurality sets of reacting tubes parallel arranged with one another, in which screw conveyors are provided, each screw conveyer rotating in an opposite direction with the rotation of adjacent screw conveyors such that the mixture of liquid hydrocarbons and residues is pushed continuously forward from the beginning of the tubes to the end of the tubes, while the liquid hydrocarbons are fully gasified, and the residues are discharged from a residual discharging outlet.
5. The system of claim 2, characterized in that said hydrochloride removal action is carried out at a temperature of 270-800°C, chloride ion being replaced from hydrochlorides contained in said gaseous hydrocarbons and the resulting chlorine gas being expelled out of the hydrochloride removal portion.
6. The system of claim 1, characterized in that said cooling portion comprises three stages, through which most of the catalytically cracked gaseous hydrocarbons are converted into liquid hydrocarbons, while certain gaseous hydrocarbons that are non-convertible at room temperature and pressure are collected and transported back to compensate the heating capacity of the thermal cracking.
7. A system of converting waste plastics into hydrocarbon oil comprising:
  - (1) a thermal cracking reactor, into which solid waste plastics are fed and in which said waste plastics are cracked at a temperature in a range of 270-800°C to obtain a thermal cracking resultant of partly gaseous hydrocarbons and partly a mixture of liquid hydrocarbons and residues;
  - (2) a catalytic cracking reactor being connected to receive the gaseous

hydrocarbons and having said gaseous hydrocarbons subject to catalytic cracking with an acid catalyst; and

5 (3) a cooling portion in which the gaseous hydrocarbons after the catalytic cracking are substantially converted into liquid hydrocarbons of smaller molecules and remaining non-convertible gaseous hydrocarbon substances; CHARACTERIZED IN THAT:

10 (4) a continuous thermal cracking and residual discharging portion is connected to receive the mixture of liquid hydrocarbons and residues from the thermal cracking reactor, in which the liquid hydrocarbons are gradually and fully cracked into gaseous hydrocarbons when passing through the continuous thermal cracking and residual discharge portion, while the dry residues from the previous thermal cracking and new residues generated from the further thermal cracking are discharged at a residual discharge outlet of the continuous thermal cracking and residual discharge portion; and

15 (5) a hydrochloride removal portion is connected to receive the gaseous hydrocarbons, respectively, from the thermal cracking reactor and from the continuous thermal cracking and residue discharging portion.

20 8. The system of claim 7, characterized in that a pressurized activation reaction portion is provided to receive the liquid hydrocarbons from the cooling portion to solidify few amount of sulfur, nitrogen, phosphorus contained in the liquid hydrocarbons so as to obtain purified hydrocarbon oils.

25 9. The system of claim 7 or 8, characterized in that the thermal cracking and residual discharging portion comprises a plurality of continuous reacting tubes of parallel arrangement, and screw-propelling conveyors mounted inside the tubes, wherein the mixture of the liquid hydrocarbons and residues is pushed forward by said screw conveyors, and passes through the reacting tubes, while 30 the mixture is maintained at a high temperature sufficient to enable complete gasification of the liquid hydrocarbons.

10. The system of claim 7, characterized in that in said hydrochloride removal portion the thermal cracking resultants is in reaction with alkaline substances to

replace the chlorine from the hydrochloride contained in the thermal cracking resultants so as to obtain purified gaseous hydrocarbons, and the hydrochloride removal reaction is carried out at a high temperature in a range of 270-800°C.

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11. The system of claim 7, characterized in that the cooling portion comprises three stages of cooling, whereby the catalytically cracked gaseous hydrocarbons are substantially converted into gaseous hydrocarbons of smaller molecules of eight to twenty carbon atoms.

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12. The system of claim 11, characterized in that said gaseous hydrocarbons become liquid hydrocarbons through said three cooling stages, and few gaseous hydrocarbon substances that are non-convertible at room temperature and pressure are led back to the thermal cracking reactor to compensate the 15 heating supply for the thermal cracking reaction.

13. A method of converting waste plastics into hydrocarbon oil comprising the following steps of:

- (1) feeding solid waste plastics into a thermal cracking reactor;
- (2) subjecting said solid waste plastics to thermal cracking at a temperature in a range of 270-800°C to obtain a thermal cracking resultant of partly gaseous hydrocarbons and partly a mixture of liquid hydrocarbons and residues;
- (3) passing said gaseous hydrocarbons into a catalytic cracking reactor for catalytic cracking with an acid catalyst; and
- (4) sending said catalytically cracked gaseous hydrocarbons into a cooling portion to obtain liquid hydrocarbons of smaller molecules;

CHARACTERIZED IN THAT:

- (5) said mixture of liquid hydrocarbons and residues from the thermal cracking portion is sent into a continuous thermal cracking and residual discharging portion, in which the liquid hydrocarbons are gradually and fully cracked into gaseous hydrocarbons when passing through the continuous thermal cracking and residual discharge portion, while the dry residues from the previous thermal cracking and new residues

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generated from the further thermal cracking are discharged at a residual discharging outlet of the continuous thermal cracking and residual discharge portion.

5 14. The method of claim 13, characterized in that said gaseous hydrocarbons from the thermal cracking reactor and the continue thermal cracking and residual discharging portion are sent to a hydrochloride removal portion for removing hydrochloride from said gaseous hydrocarbons to obtain chlorine free gaseous hydrocarbons before said catalytic cracking.

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15. The method of claim 13 or 14, characterized in that said liquid hydrocarbons obtained from the cooling portion are passed into a pressurized activation reaction portion in which few amount of sulfur, nitrogen, phosphorus contained in the liquid hydrocarbons are solidified so as to obtain purified hydrocarbon oils.

16. The method of claim 13, 14 or 15, characterized in that said continuous thermal cracking in said continuous thermal cracking and residual discharging portion is carried out at a temperature range of 270-800°C.

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17. The method of claim 14, characterized in that said hydrochloride removal reaction is carried out in presence of alkaline metathetic substances at a temperature of 270-800°C.

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18. The method of claim 13, characterized in that said cooling is a three-stage cooling, through which most of the gaseous hydrocarbons are turned into liquid hydrocarbons, and few amount of gaseous substances that are not convertible at room temperature and pressure are led back to the thermal cracking reactor to generate additional heating for the thermal cracking.

30

19. The method of claim 15, characterized by further comprising a step of separation of hydrocarbon oils from the pressured activation reactor to obtain further purified hydrocarbon oils by means of a centrifuge.

20. A method of converting waste plastics into hydrocarbon oil comprising the following steps of:

- (1) feeding solid waste plastics into a thermal cracking reactor;
- (2) subjecting said solid waste plastics to thermal cracking at a temperature in a range of 270-800°C to obtain a thermal cracking resultant of partly gaseous hydrocarbons and partly a mixture of liquid hydrocarbons and residues;
- 5 (3) passing said gaseous hydrocarbons into a catalytic cracking reactor for catalytic cracking with an acid catalyst; and
- 10 (4) sending said catalytically cracked gaseous hydrocarbons into a cooling portion to obtain liquid hydrocarbons of smaller molecules;  
CHARACTERIZED BY:
- (5) passing said mixture of liquid hydrocarbons and residues into a continuous thermal cracking and residual discharging portion, in which the liquid hydrocarbons are gradually and fully cracked into gaseous hydrocarbons when passing through the continuous thermal cracking and residual discharging portion, while the dry residues from the previous thermal cracking and new residues generated from the further thermal cracking are discharged at a residual discharging outlet of the 15 continuous thermal cracking and residual discharge portion; and
- 20 (6) sending said gaseous hydrocarbons from the thermal cracking reactor and from the continuous thermal cracking and residual discharging portion to a hydrochloride removal portion for removing hydrochloride from said gaseous hydrocarbons to obtain chlorine free gaseous hydrocarbons before said catalytic cracking.
- 25

21. The method of claim 20, characterized by further comprising a step of passing said liquid hydrocarbons from said cooling stage into a pressurized activation reaction portion to have few amount of sulfur, nitrogen, phosphorus contained 30 in the liquid hydrocarbons solidified so as to obtain purified hydrocarbon oils.

22. The method of claim 20 or 21, characterized in that said continuous thermal cracking is carried out in a plurality of continuous reacting tubes of predetermined length parallel arranged at a temperature range of 270-800°C.

23. The method of claim 20, characterized in that said hydrochloride removal reaction is carried out in presence of alkaline metathetic substances at a temperature range of 270-800°C.

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24. The method of claim 20, characterized in that said catalytically cracked gaseous hydrocarbons are passed through three stages of cooling, such that most of the gaseous hydrocarbons are converted into liquid hydrocarbons of smaller molecules, while certain gaseous hydrocarbons that are not convertible at room temperature and pressure are led back to compensate the heating capacity of thermal cracking.

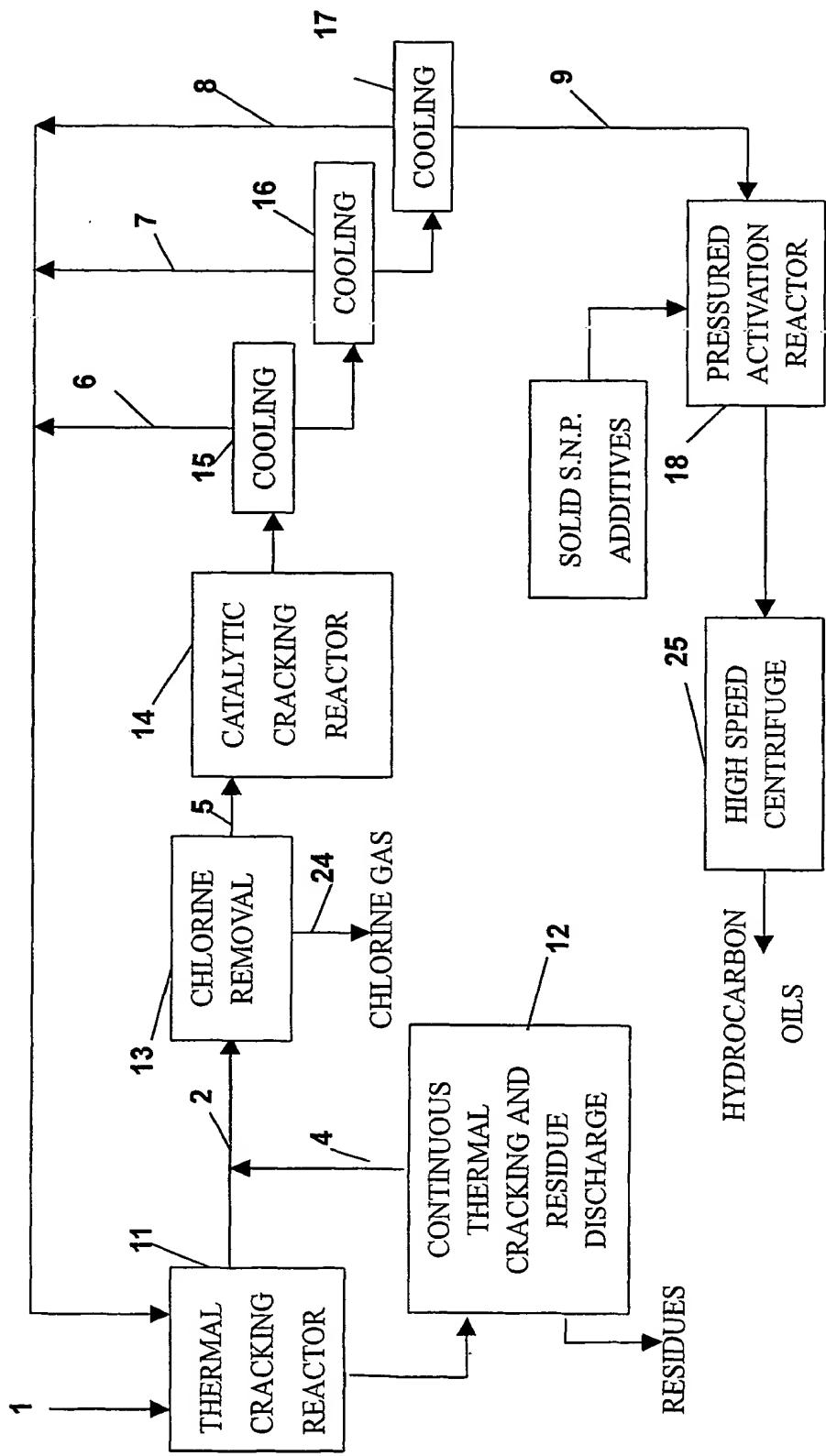
10

25. The method of claim 21, characterized in that the liquid hydrocarbon oils is subject to a separation process by means of a centrifuge.

15

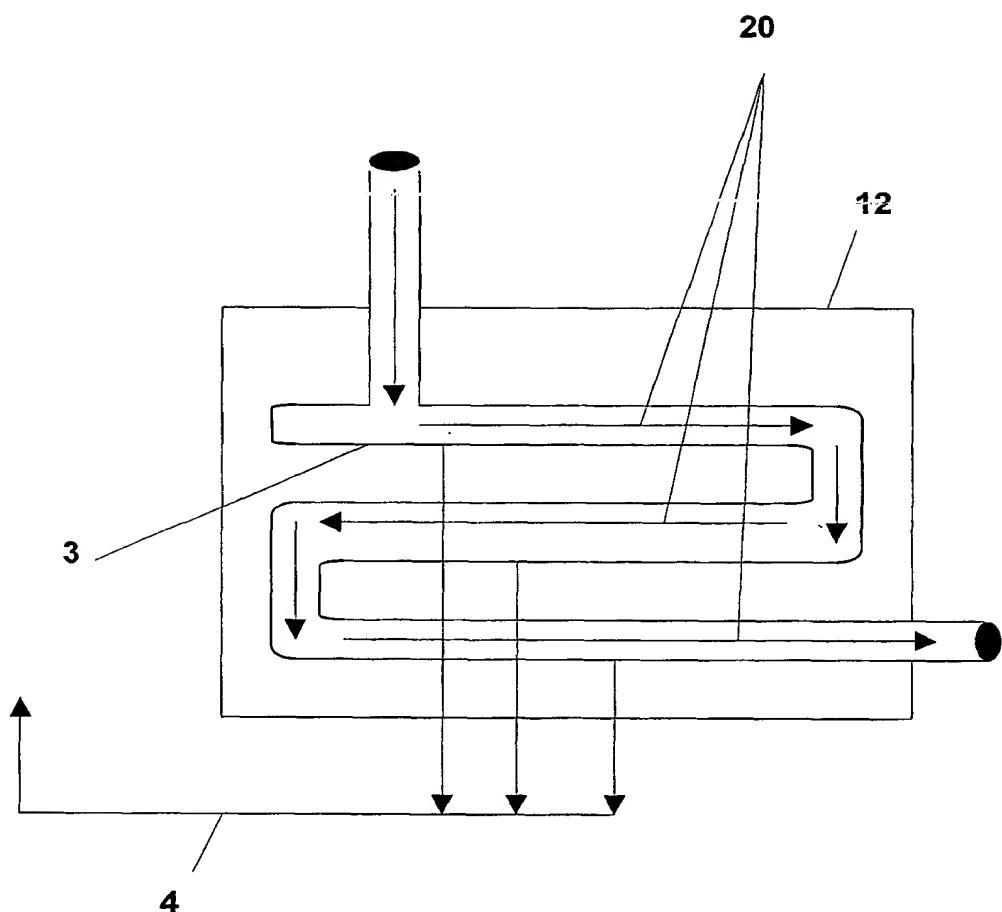
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FIG. 1



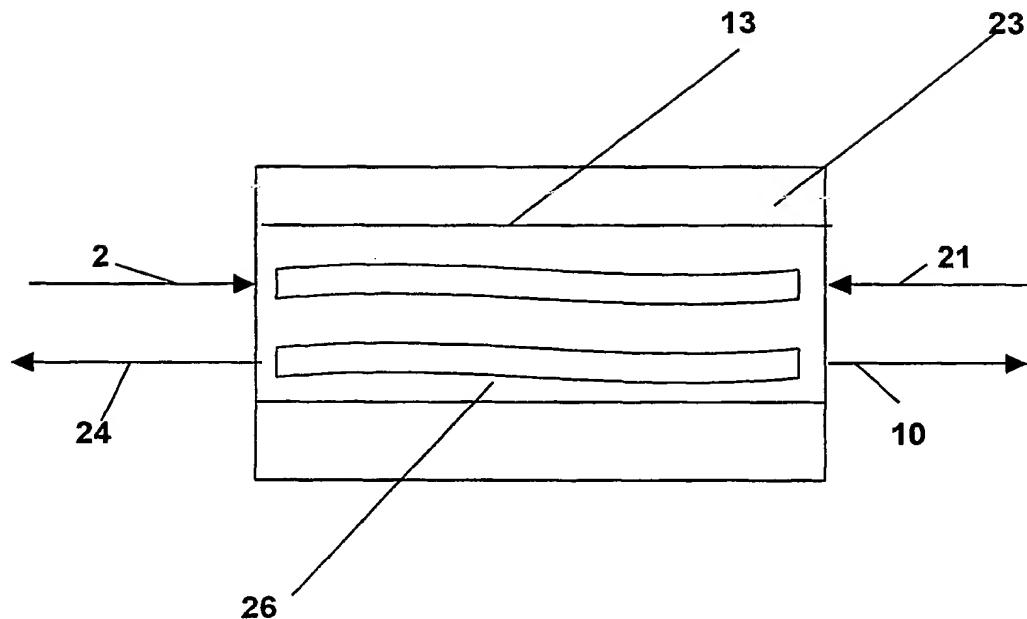
2/3

FIG. 2



3/3

FIG. 3



# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/CN01/00099

## A. CLASSIFICATION OF SUBJECT MATTER

IPC<sup>7</sup> C10G 1/00, C10G 1/10, C08J11/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC<sup>7</sup> C10G, C08J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, DDBJ, PDB, PIR, WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 1127519 A, 24/Jul/1996, claims: 1-10	1-25
Y	CN 1236804 A, 1/Dec/1999, claims: 1-2	1-25
Y	CN 1126237 A, 10/Jul/1996, claims: 1-5	1-25
A	CN 1075328 A, 18/Aug/1993, abstract	1-25
A	CN 1016072 B, 01/Apr/1992, abstract	1-25
A	CN 1130652 A, 11/Sep/1996, abstract	1-25
A	CN 1077479 A, 20/Oct/1993, abstract	1-25

Further documents are listed in the continuation of Box C.  See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search 25.Mar.2001 (25.03.01)	Date of mailing of the international search report 05 APR 2001 (05.04.01)
Name and mailing address of the ISA/CN 6 Xitucheng Rd., Jimen Bridge, Haidian District, 100088 Beijing, China Facsimile No. 86-10-62019451	Authorized officer Wang PengFei Telephone No. 86-10-62093145

# PCT

## REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference  
(if desired) (12 characters maximum) CPS10381

### Box No. I TITLE OF INVENTION

METHOD AND SYSTEM OF CONVERTING WASTE PLASTICS INTO HYDROCARBON OIL

### Box No. II APPLICANT

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

JIANG Tianfu  
Zao Jun Xi Li, Building No. 2, Apt. 1-501  
Haidian District, Beijing 100081  
People's Republic of China

This person is also inventor.

Telephone No.

6215-4294

Faxsimile No.

Teleprinter No.

State (that is, country) of nationality:

People's Republic of China

State (that is, country) of residence:

China

This person is applicant  all designated States  all designated States except the United States of America  the United States of America only  the States indicated in the Supplemental Box

### Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

CHEN Yanping  
Zao Jun Xi Li, Building No. 2, Apt. 1-501  
Haidian District, Beijing 100081  
People's Republic of China

This person is:

applicant only

applicant and inventor

inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

People's Republic of China

State (that is, country) of residence:

China

This person is applicant  all designated States  all designated States except the United States of America  the United States of America only  the States indicated in the Supplemental Box

Further applicants and/or (further) inventors are indicated on a continuation sheet.

### Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:

agent

common representative

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

Jay Sha  
Jeekai & Partners  
Suite 602, Jinyu Tower  
A129 West Xuan Wu Men Street  
Beijing 100031, P. R. China

Telephone No.

86 10 6641-1409

Faxsimile No.

86 10 6641-1419

Teleprinter No.

Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

## Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

GUO Wuyi

Zao Jun Xi Li, Building No. 2, Apt. 1-501  
Haidian District, Beijing 100081  
People's Republic of China

This person is:

applicant only  
 applicant and inventor  
 inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:  
People's Republic of China

State (that is, country) of residence:  
China

This person is applicant for the purposes of:  all designated States  all designated States except the United States of America  the United States of America only  the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

applicant only  
 applicant and inventor  
 inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of:  all designated States  all designated States except the United States of America  the United States of America only  the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

applicant only  
 applicant and inventor  
 inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of:  all designated States  all designated States except the United States of America  the United States of America only  the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

applicant only  
 applicant and inventor  
 inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of:  all designated States  all designated States except the United States of America  the United States of America only  the States indicated in the Supplemental Box

Further applicants and/or (further) inventors are indicated on another continuation sheet.

## Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

## Regional Patent

AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, MZ Mozambique, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT

EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT

EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT

OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line) .....

## National Patent (if other kind of protection or treatment desired, specify on dotted line):

<input checked="" type="checkbox"/> AE United Arab Emirates .....	<input checked="" type="checkbox"/> LC Saint Lucia .....
<input checked="" type="checkbox"/> AG Antigua and Barbuda .....	<input checked="" type="checkbox"/> LK Sri Lanka .....
<input checked="" type="checkbox"/> AL Albania .....	<input checked="" type="checkbox"/> LR Liberia .....
<input checked="" type="checkbox"/> AM Armenia .....	<input checked="" type="checkbox"/> LS Lesotho .....
<input checked="" type="checkbox"/> AT Austria .....	<input checked="" type="checkbox"/> LT Lithuania .....
<input checked="" type="checkbox"/> AU Australia .....	<input checked="" type="checkbox"/> LU Luxembourg .....
<input checked="" type="checkbox"/> AZ Azerbaijan .....	<input checked="" type="checkbox"/> LV Latvia .....
<input checked="" type="checkbox"/> BA Bosnia and Herzegovina .....	<input checked="" type="checkbox"/> MA Morocco .....
<input checked="" type="checkbox"/> BB Barbados .....	<input checked="" type="checkbox"/> MD Republic of Moldova .....
<input checked="" type="checkbox"/> BG Bulgaria .....	<input checked="" type="checkbox"/> MG Madagascar .....
<input checked="" type="checkbox"/> BR Brazil .....	<input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia .....
<input checked="" type="checkbox"/> BY Belarus .....	<input checked="" type="checkbox"/> MN Mongolia .....
<input checked="" type="checkbox"/> BZ Belize .....	<input checked="" type="checkbox"/> MW Malawi .....
<input checked="" type="checkbox"/> CA Canada .....	<input checked="" type="checkbox"/> MX Mexico .....
<input checked="" type="checkbox"/> CH and LI Switzerland and Liechtenstein .....	<input checked="" type="checkbox"/> MZ Mozambique .....
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<input checked="" type="checkbox"/> GD Grenada .....	<input checked="" type="checkbox"/> TJ Tajikistan .....
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<input checked="" type="checkbox"/> GM Gambia .....	<input checked="" type="checkbox"/> TT Trinidad and Tobago .....
<input checked="" type="checkbox"/> HR Croatia .....	<input checked="" type="checkbox"/> TZ United Republic of Tanzania .....
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**Precautionary Designation Statement:** In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)

Box No. VI PRIORITY CLAIM		<input type="checkbox"/> Further priority claims are indicated in the Supplemental Box.		
Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: * regional Office	international application: receiving Office
item (1)				
item (2)				
item (3)				

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s): \_\_\_\_\_

\* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.

#### Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) (if two or more International Searching Authorities are competent to carry out the international search; indicate the Authority chosen; the two-letter code may be used): ISA / CN	Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority): Date (day/month/year) _____ Number _____ Country (or regional Office) _____		
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#### Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following number of sheets:  request : 4 description (excluding sequence listing part) : 10 claims : 7 abstract : 1 drawings : 3 sequence listing part of description : _____  Total number of sheets : 25	This international application is accompanied by the item(s) marked below:  1. <input checked="" type="checkbox"/> fee calculation sheet 2. <input checked="" type="checkbox"/> separate signed power of attorney 3. <input type="checkbox"/> copy of general power of attorney; reference number, if any: 4. <input type="checkbox"/> statement explaining lack of signature 5. <input type="checkbox"/> priority document(s) identified in Box No. VI as item(s): 6. <input type="checkbox"/> translation of international application into (language): 7. <input type="checkbox"/> separate indications concerning deposited microorganism or other biological material 8. <input type="checkbox"/> nucleotide and/or amino acid sequence listing in computer readable form 9. <input type="checkbox"/> other (specify): _____
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Figure of the drawings which should accompany the abstract: Fig. 1      Language of filing of the international application: English

#### Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).



— For receiving Office use only —		
1. Date of actual receipt of the purported international application:		2. Drawings:  <input type="checkbox"/> received:  <input type="checkbox"/> not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:		
4. Date of timely receipt of the required corrections under PCT Article 11(2):		
5. International Searching Authority (if two or more are competent): ISA /	6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid.	

— For International Bureau use only —

Date of receipt of the record copy by the International Bureau:

This sheet is not part of and does not count as a sheet of the international application.

**PCT**  
**FEES CALCULATION SHEET**  
**Annex to the Request**

For receiving Office use only

Applicant's or agent's  
file reference CPS10381

International application No.

Date stamp of the receiving Office

Applicant

JIANG Tianfu, CHEN Yanping, GUO Wuyi

**CALCULATION OF PRESCRIBED FEES**

1. TRANSMITTAL FEE . . . . . CNY500

2. SEARCH FEE . . . . . CNY800

International search to be carried out by Chinese Patent Office

(If two or more International Searching Authorities are competent in relation to the international application, indicate the name of the authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

**Basic Fee**

The international application contains 25 sheets.

first 30 sheets . . . . . CHF162.50

remaining sheets x additional amount

650.50

b1

b2

Add amounts entered at b1 and b2 and enter total at B . . . . . CHF162.50 650.50

**Designation Fees**

The international application contains 87 designations.

8 6 x 140 = CHF280.00

number of designation fees amount of designation fee  
payable (maximum 8)

840.50

149.60  
10.25

372.50

CHF442.50

4. FEE FOR PRIORITY DOCUMENT (if applicable) . . . . .

5. TOTAL FEES PAYABLE . . . . .

CNY1300, CHF442.50

The designation fees are not paid at this time.

**MODE OF PAYMENT**

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deposit account (see below)  
 cheque  
 postal money order

bank draft  
 cash  
 revenue stamps

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 other (specify):

**DEPOSIT ACCOUNT AUTHORIZATION (this mode of payment may not be available at all receiving Offices)**

The RO/  is hereby authorized to charge the total fees indicated above to my deposit account.

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# PCT

## POWER OF ATTORNEY (for an international application filed under the Patent Cooperation Treaty) (PCT Rule 90.4)

The undersigned applicant(s) (Names should be indicated as they appear in the request):  
JIANG Tianfu, CHEN Yanping, GUO Wuyi

hereby appoints (appoint) the following person as:

agent

common representative

### Name and address

(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

Jeekai & Partners  
Suite 602, Jinyu Tower  
A129 West Xuan Wu Men Street  
Beijing 100031, P. R. China

to represent the undersigned before

all the competent International Authorities

the International Searching Authority only

the International Preliminary Examining Authority only

in connection with the international application identified below:

**Title of the invention:** METHOD AND SYSTEM OF CONVERTING WASTE PLASTICS INTO HYDROCARBON OIL

**Applicant's or agent's file reference:** CPS10381

**International application number (if already available):**

filed with the following Office State Intellectual Property Office of People's Republic of China as receiving Office and to make or receive payments on behalf of the undersigned.

**Signature of the applicant(s)** (where there are several applicants, each of them must sign; next to each signature, indicate the name of the person signing and the capacity in which the person signs, if such capacity is not obvious from reading the request or this power):

Jiang Tianfu  
chen yanping

Guo Wu Yi

Date: January 21, 2001